National Semiconductor

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LM1391 Phase-Locked Loop

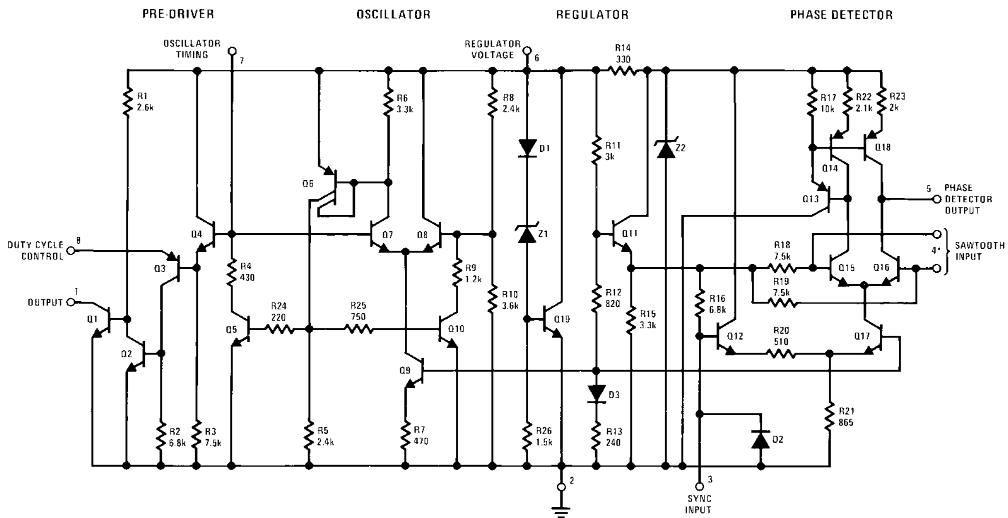
General Description

The LM1391 integrated circuit has been designed primarily for use in the horizontal section of TV receivers, but may find use in other low frequency signal processing applications. It includes a stable VCO, linear pulse phase detector, and variable duty cycle output driver.

Features

- Internal active regulator for improved supply rejection
- Uncommitted collector of output transistor
- Output transistor with low saturation and high voltage swing
- APC of the oscillator with a synchronizing signal
- DC controlled output duty cycle
- ±300 Hz typical pull-in
- Linear balanced phase detector
- Low thermal frequency drift
- Small static phase error
- Adjustable DC loop gain

Schematic Diagram



TL/H/7889–1

(*) Pin 4 Base of Q16 (LM1391) for use with (+) flyback pulse

Absolute Maximum Ratings

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

Supply Current	40 mA_{DC}
Output Voltage	40 V_{DC}
Output Current	30 mA_{DC}
Sync Input Voltage (Pin 3)	5.0 Vp-p
Flyback Input Voltage (Pin 4)	5.0 Vp-p
Power Dissipation (Package Limitation)	
Plastic Package (Note 1)	1000 mW
Operating Temperature Range (Ambient)	0°C to +70°C
Storage Temperature Range	−65°C to +150°C
Lead Temperature (Soldering, 10 sec.)	260°C

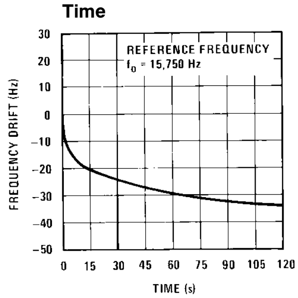
Electrical Characteristics T_A = 25°C (see test circuit, all switches in position 1)

Parameter	Conditions	Min	Typ	Max	Units
Regulated Voltage (Pin 6)	I_6 = 22 mA_{DC}	8.0	8.6	9.2	V_{DC}
Supply Current (Pin 6)			20		mA_{DC}
Collector-Emitter Saturation Voltage of Output Transistor (Pin 1)	I_{C1} = 20 mA		0.30	0.40	V_{DC}
Pin 4 Voltage			2.0		V_{DC}
Oscillator Pull-in Range	Adjust R_H		±300		Hz
Oscillator Hold-in Range	Adjust R_H		±900		Hz
Static Phase Error	Δf = 300 Hz		0.5		μs
Free-running Frequency Supply Dependance	S1 in position 2		±3.0		Hz/V_{DC}
Phase Detector Leakage (Pin 5)	All switches in position 2			±1.0	μA
Sync Input Voltage (Pin 3)		2.0		5.0	Vp-p
Sawtooth Input Voltage (Pin 4)		1.0		3.0	Vp-p
Maximum Oscillator Frequency			500		kHz

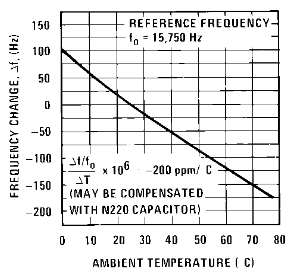
Note 1: For operation in ambient temperatures above 25°C, the device must be derated based on a 150°C maximum junction temperature and a thermal resistance of 120°C/W junction to ambient.

Typical Performance Characteristics

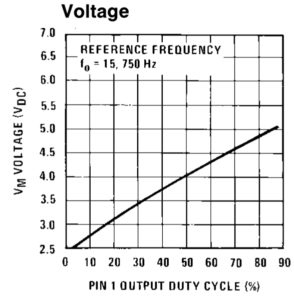
Frequency Drift vs Warm-Up Time



Frequency vs Temperature



Output Duty Cycle vs V_M Voltage



TL/H/7889–3

Application Information

The following equations may be considered when using the LM1391 in a particular application.

$$R201 = R301 = \frac{V_{CC} - 8.6}{0.02}\,\Omega$$

$$f_O \cong \frac{1}{0.6\,R_O C_O}\text{ Hz } 1.5\text{k} \le R_O < 51\text{k}$$

$$R204 \cong 10\,R_O$$

$$C203 = C204 \cong \frac{1}{600\,f_O(\text{Hz})}\text{ F}$$

DC Loop Gain $\mu\beta \cong 3.2 \times 10^{-5}\,R_O f_O$ Hz/rad

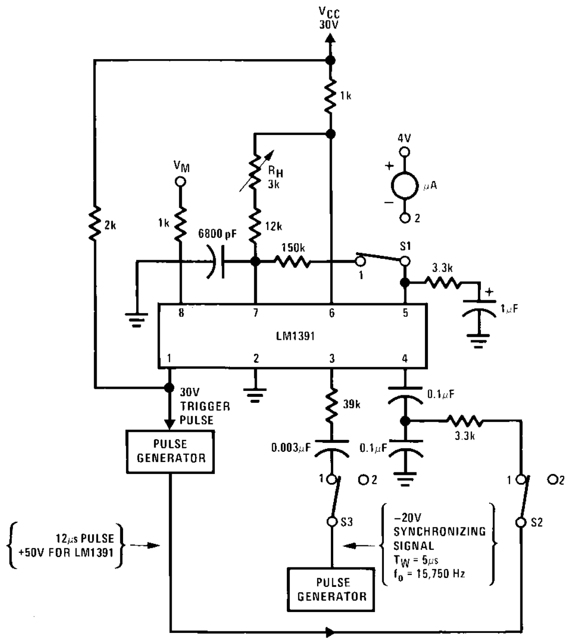
Noise Bandwidth

$$f_{nn} \cong \frac{1 + 2\pi \dfrac{R_X{}^2}{R_Y} C_C\,\mu\beta}{4R_X C_C}\text{ Hz}$$

Damping Factor

$$K \cong \frac{\pi}{2}\frac{R_X{}^2}{R_Y} C_C\,\mu\beta$$

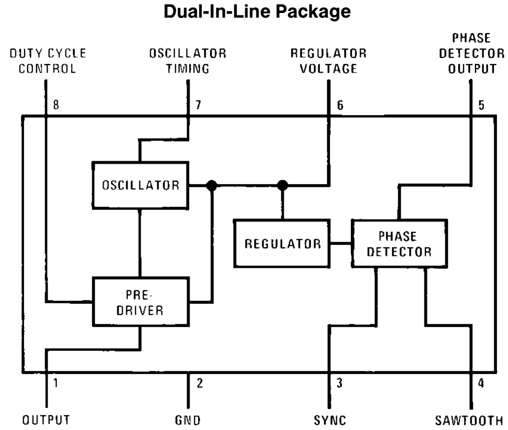
Test Circuit



TL/H/7889–4

Connection Diagram

Dual-In-Line Package



TL/H/7889–2

Top View
Order Number LM1391N
See NS Package Number N08E

Typical Applications

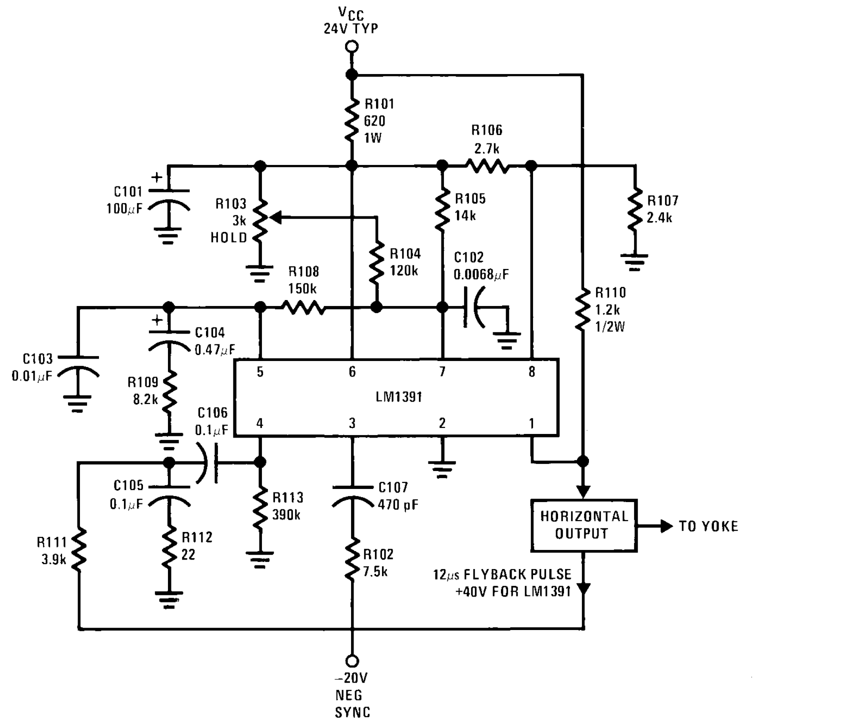


FIGURE 1. TV Horizontal Processor

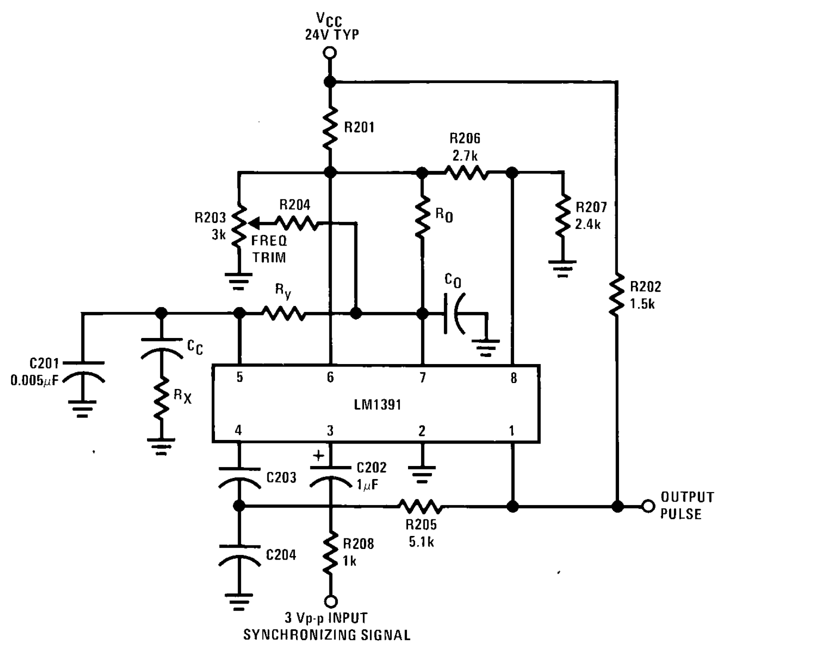
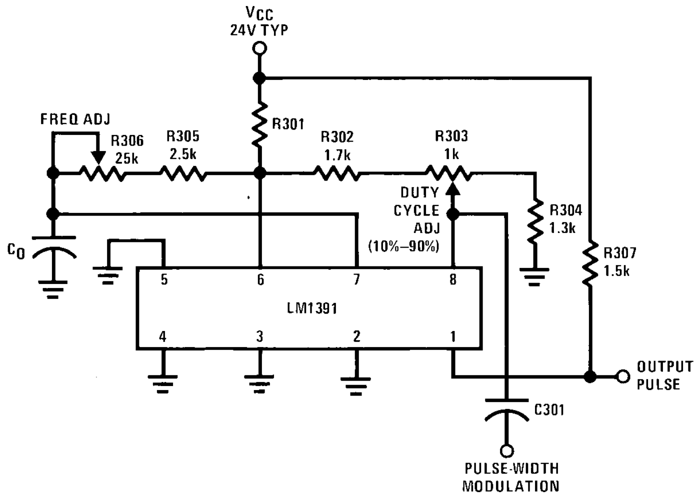


FIGURE 2. General Purpose Phase-Lock Loop
(See Applications Information)

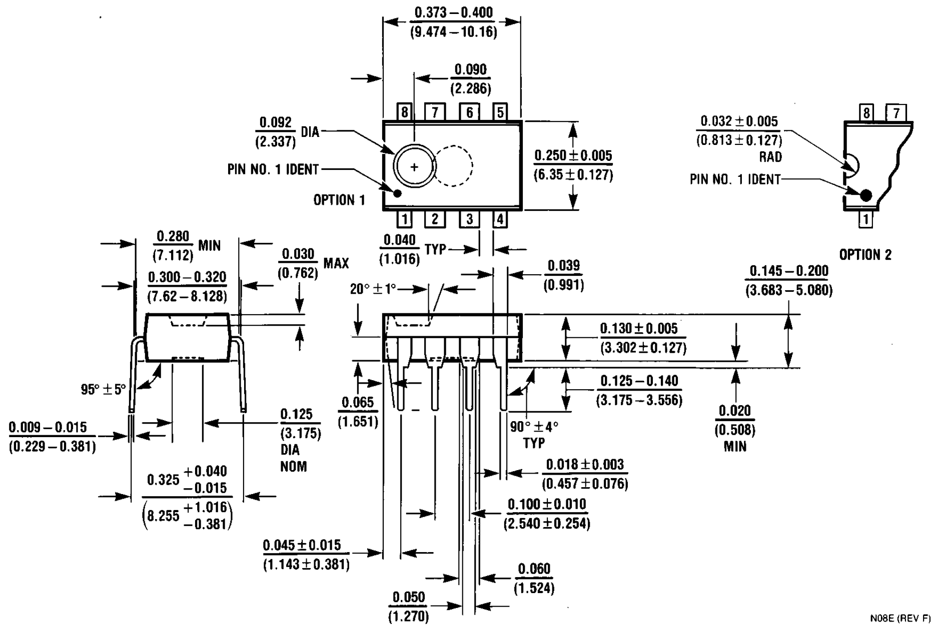
Typical Applications (Continued)



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FIGURE 3. Variable Duty Cycle Oscillator
(See Applications Information)

Physical Dimensions inches (millimeters)



Molded Dual-In-Line Package (N)
Order Number LM1391N
NS Package Number N08E

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